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Performance Evaluation of Mechanical Rice Transplanter for *Aman* Rice

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Abstract

A study was conducted during *Aman*/2012 season on mechanical rice transplanter to evaluate the field performance in both puddle and un-puddle conditions in the locations of Laksam and Burichong Upazila of Comilla district and Kumarkhali Upazila of Kushtria district represented the sandy loam, clay loam and clay soil condition respectively under PhD works. Walk behind type 4 rows mechanical rice transplanter was used to conduct the study. Seedling was raised in plastic tray and polythene sheet for transplanting. Puddle field was prepared by three tilling and one leveling operation by two wheel power tiller. In un-puddle field, major weeds were only removed manually. Mechanical rice transplanter was found suitable to operate in un-puddle condition with some pre-requisite management. Managements are the inundation of land for making soil soft, weeds out and maintain minimum standing water during transplanting. Plant to plant distance was found less in puddle field compared to un-puddle field because of slippage during transplanting. In puddle field, average plant to plant distance was found 14.42 cm whereas it was 14.85 cm in un-puddle field out of 15 cm. On the other hand, transplanting depth was observed almost same in both conditions because of controlling mechanism of depth in rice transplanter. However, average total missing hills considering missing, floating, buried and damaged hills was found 3.60 and 4.92 hills/m^2 in puddle and un-puddle fields respectively. Floating hills was observed more in un-puddle field though buried hills was more in puddle hills. Moreover, percent of missing hills in puddle and un-puddle conditions were 14.94 and 21.04% respectively. In both puddle and un-puddle conditions, % of total missing hills was found more in clay soil condition whereas it was observed less in sandy loam condition. Field capacity also varied due to vibration in un-puddle condition. Average filed capacity was found 0.14 and 0.13 ha/hr in puddle and un-puddle conditions respectively. Yield and yield contributing characters have no significant different in puddle and un-puddle field. Average yield of the BRRI dhan49 was 5.1 and 4.87 t/ha whereas 4.92 and 4.89 t/ha for BINA dhan7 in puddle and un-puddle field respectively. BCR of rice production under puddle and un-puddle conditions, transplanting by mechanical transplanter, was gave 1.49 and 1.56 respectively.

Key words: Mechanical rice transplanter, Conventional tillage, Zero tillage, Total missing hills, Yield and BCR

1. Introduction

Rice has become the second most important cereal in the world after wheat in terms of production due to a recent decline of maize production (Jones, 1995). Rice is the staple food for nearly half of the world's population, most of who live in Asia (Sattar, 1994). However, rice is the main source of energy and cash income for most of the farmers in Bangladesh (BARC, 1983). Asia as a whole contributes to about 92 percent of the world's rice harvest. Bangladesh ranks fourth in the world both in area and production (FAO, 1994) and 39th in yield among the rice growing countries (IRRI, 1995). Today’s intensive agriculture leaves only a very limited time between harvesting of one crop and sowing/transplanting of the next one. Transplanting of crops is the most important agricultural operations which demand considerable amount of labor. Shortage of labor and draught power in agriculture has become serious problem during peak period of transplanting. Moreover, Bangladesh does not have any additional land for expanding cultivation. In this context, farm mechanization with small, low cost and ease to operate farm machinery could lead to make cultivation more profitable and to maximize production. Due to shortage of human labor, farmers are compelled to practice delayed planting which results in yield loss. It is therefore essential to adopt the mechanical transplanter to ensure the timeliness in transplanting. Rice transplanting is a highly labor intensive farm operation.

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The total labor requirement for rice production in 1 hectare of land was 156.2 man-days of which 44.5 man-days were consumed by seedling raising and transplanting which is 28.24% of the total labor requirement (Rahman, 1997). The yield losses due to delayed planting were 60.0, 55.4 and 9.0 kg/ha/day in the Boro, *Aman* and Aus seasons, respectively (Satter, 1999). On the other hand, land preparation is one of the important activities in rice production. Although, land tilling activity of rice production is mechanized significantly in Bangladesh, 18 % of total production cost is involved in land tilling and leveling purpose. In Japan, no-tillage rice production has received attention because it saves time and labor before planting. And it was expected as crop production method for environmental conservation. For example, CH_4 emission from paddy field accounts for 29% of the total man-caused emission (Matsunaka, 2003), and it is apparent that CH_4 emission in no-tillage is less than that in conventional tillage (Itoh, 2002). No-tillage is a promising solution for global warming. Mechanical rice transplanting is being introduced in Bangladesh and gaining popularity through the different intervention of some Governmental and Non-governmental organization. Considering the farmers demand and cost involvement in land preparation, an attempt has been under taken to evaluate the rice transplanter in un-puddle condition with the following objectives.

Objectives

- To evaluate the mechanical rice transplanter in un-puddle conditions
- To observe the yield and yield contributing parameters
- To compare the cost of rice production in puddle and un-puddle conditions

2. Methodology

The experiment was conducted in Laksam and Burichong Upazila of Comilla district and Kumarkhali Upazila of Kushtria district during *Aman* 2012 season representing the sandy loam, clay loam and clay soil condition respectively with the following treatments.

2.1 Treatments

T_1: Conventional tillage (Transplanting in puddle condition)
T_2: Zéro tillage (Transplanting in un-puddle condition)

RCB design was used with three replications. Seedling was raised in both plastic tray and polythene sheet. Walk behind type 4 rows mechanical rice transplanter was used to conduct the study. BRRI dhan49 was transplanted in Laksam and Burichong, Comilla and BINA dhan7 was in Kumarkhali, Kushtia. 20 days old seedling was transplanted with the spacing of 30×15 cm.

2.2 Land preparation

In Puddle field, land was tilled and leveled by 2 wheel power tiller. Three tilling and one leveling operation were done for land preparation. After land preparation, the field was kept two days for soil settlement. 1-2 cm standing water was maintained during transplanting operation. In un-puddle field, straw of *Boro* crops were removed manually cutting by sickle near the surface. Weeds of the un-puddle field was also removed manually before transplanting as much as possible to make the field clean.

2.3 Experimental characteristics

BRRI recommended fertilizer dose was applied for BRRI dhan49 and BINA dhan7 to conduct the study. Triple super phosphate (TSP), muriate of potash (MoP), zinc sulphate ($ZnSo_4$) and Gypsum fertilizer was used as basal dress fertilizer. Urea fertilizer was used as top dress in three different times as follows. The rate of basal dose and top dress of fertilizer is given in Table 1. General information of the experiment is also presented in the Table 1.

Table 1. General information of the experiment

Place	Soil texture	Variety	Plot size, ha		Fertilizer rate (kg/ha)					D/S	D/T	Urea application, DAT			Date of harvesting
			Puddle	Un-puddle	TSP	MOP	Gyp	$ZnSO_4$	Urea			1st TD	2nd TD	3rd TD	
Kumarkhali Kushtia	Clay	BINA dhan7	0.19	0.12	105	75	75	7.5	180	12/7/12	31/7/12	15	30	-	11/11/12
Laksam Comilla	Sandy loam	BRRI dhan49	0.14	0.08	80	80	80	7.5	185	2/7/12	20/7/12	12	28	-	13/11/12
Burichong Comilla	Clay loam	BRRI dhan49	0.13	0.10	100	90	80	7.5	185	5/7/12	20/7/12	12	28	-	13/11/12

2.4 Fuel consumption

Fuel consumption was measured during transplanting operation of mechanical rice transplanter. Fuel tank was filled both before and after operation for measuring the fuel consumption. Fuel consumption was measured as follows:

$$F_C = \frac{\mathrm{Vf}}{\mathrm{t}}$$

Where, F_c = Fuel consumption, lit/hr
V_f = Filled volume of fuel after operation, lit
t = Time of operation, hr

2.5 Transplanter setting during operation

There have three options in the walk behind type mechanical rice transplanter to adjust plant to plant spacing. 15 cm plant to plant spacing was adjusted during transplanting. There have also three options for depth of seedling placing. In the puddle field, transplanting depth control lever was set at slight mode where as it was set at deep mode in un-puddle field. Number of seedlings/hill was adjusted considering seedling density for maintaining same number of plants/hill. There have nine options to select number of seedling per hills. During transplanting, option 5 was adjusted for transplanting.

2.6 Transplanter performance

Field capacity: Field capacity of transplanter was calculated considering turning time, seedling feeding time, operators personal time, adjustment time etc.

$$\text{Field capacity (ha/hr)} = \frac{\text{Area of transplanting, ha}}{\text{Time of operation, hr}} x100$$

2.6.1 Transplanting data collection: Transplanting data regarding missing hills, damage hills, floating hills, buried hills, depth of seedling placing and plant to plant distance was counted from 1.0 m^2 selected area in each plots.

2.7 Soil resistance

Hand Penetrometer Eijkelkamp was used to measure the soil penetration resistance (Model: Ejkelkemo, Serial no. 27180909, Netherlands) of the both puddle and un-puddle field before transplanting. Cone resistance was calculated using the following formula:

$$\text{Cone resistance} = \frac{\text{Manometer reading}}{\text{Base area of cone}} \mathrm{N/cm^2}\ (100\ \mathrm{N/cm^2} = 1\,\mathrm{Mpa})$$

3 and 4 nos cone were used to measure the soil resistance. Base area of cone 1, 2, 3 and 4 is 1, 2, 3.33 and 5 cm^2 respectively. Soil strength was measured from the soil surface to a depth of 22 cm. Penetrometer readings were taken randomly in three places of the each plots.

2.8 Weed management

Boro rice was the previous crops in the study plots. After *Boro* rice harvesting, rain water was stored in the field to make the soil soft. Straw of *Boro* rice and weeds was removed before transplanting manually cutting by sickle at the near of the soil surface. Hand weeding operation was done in two different times to keep the field weeds free. Weeding operation was done at 15 and 40 DAT.

2.9 Yield and yield contributing data collection

10 m^2 area was selected randomly from each plot to collect yield and yield contributing data. Yield data was collected from 10 m^2 area and adjusted to 14% moisture content. Straw yield, number of tillers/hill and number of panicles/hill was counted from 1 m^2 area outside of 10 m^2 pre-selected areas. Number of hills/m^2 was counted from total number of hills in 10 m^2 pre-selected area. Plant height, panicle length, number of filled grains/panicle, number of un-filled grains/panicle, 1000 grains weight were counted from three hills randomly taken from each 1 m^2 area. The straw of three hills also added with straw of 1 m^2 area for straw yield calculation.

2.10 General feature of the transplanter

Korean made walk behind type 4 rows rice transplanter was used to conduct the study. During test, flexible plastic tray (58 x 28 x 2.5 cm) and polythene sheet methods were used to raise seedling for the transplanter. The technical specifications are presented in Table 2.

2.11 Seedling raising

Plastic tray (28 × 58 × 2.5 cm) and polythene sheet methods were used for raising seedling. The sandy loam soil was collected for preparation of seedbed. To ensure soil free from clod, crop residues and weeds grinded the soil properly. At first clod free sandy loam soil mixed with organic fertilizer, filled up the tray and spread over the polythene sheet at a thickness of 2.0cm. 130g pre-germinated seeds were spread in each tray or 0.145 m^2 area of polythene sheet. The amount of seeds per tray depends on the 1000 grains weight of the recommended seed. In general, 120-150g pre-germinated seeds of normal varieties (inbreed) and 80-100g seeds of hydride rice are sowed per tray or 0.145 m^2 area of polythene sheet. When the radicals and coleoptiles elongate to 1/3 of seed length is desired for pre-germinated seed to broadcast on the tray. To ensure uniform broadcasting, the whole seeds lot divided into 2-3 parts for uniform broadcasting. After sowing, fine and loose soil was spread over the seeds to 0.3-0.5cm thick and therefore the trays were kept under a shade to avoid birds attacked. After covering seeds, the two trays were placed side by side along each bed, make the bottoms of trays be in contact closely with the surface of the beds and irrigated the seedbed to an extent that the level of water just reaches the bottom of the trays and drain water after the soil get saturated. In case of seedling on polythene sheet, wooden/bamboo made frame was used as ridge to protect the soil and irrigation water. To drain excess water, canals are provided among the beds. 18 days older seedling with 3-4 leaves was used in this experiment (Fig. 1 & 2).

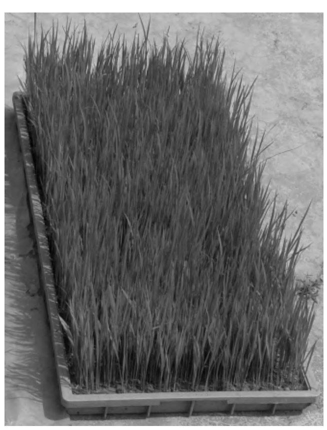

Fig. 1. Seedling raised on plastic tray

Fig. 2. Seedling raised on polythene sheet

Table 2. Specification of Walking Type Rice Transplanter

Description of items			
Country of origin			South Korea
Model			DP480
Type			Walk behind Type
	Overall length (mm)		2385
	Overall width (mm)		1530
	Overall height (mm)		870
	Overall weight (kg)		160
Dimensions	Type		4-strocke, air-cooled OHV gasoline
	Displacement (CC)		147
	Maximum output kW/rpm		3/1800
	Fuel tank capacity (L)		3.4
	Starting method		Recoil
	Steering		Hydraulic power steering mode
Traveling Section	Wheel type		Rubber lug wheel
	Gearshift	Forward	2 speeds
		Reverse	1 speed
	Transplanting mechanism		Rotary
	Number of rows		4
Transplanting Section	Transplanting distance, cm (row to row)		30
	Transplanting distance, cm (plant to plant)		11,13,15
	Planting pitch control		Adjustable
	Transplanting speed, m/sec		0.6 to 1.0

3. Results and Discussion

Before transplanting, cone penetration resistance of soil was measured using cone Penetrometer. The recorded data was presented in fig. 3-5.

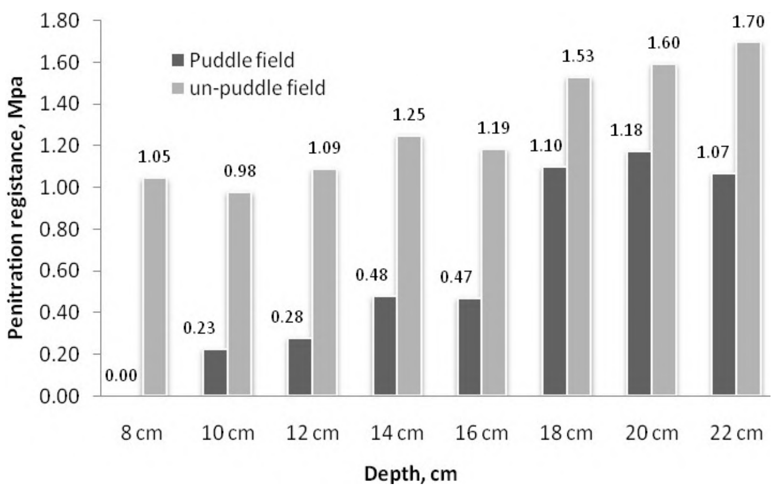

Fig. 3. Cone penetration resistance of clay type soil during transplanting at Kumarkhali, Kushtia

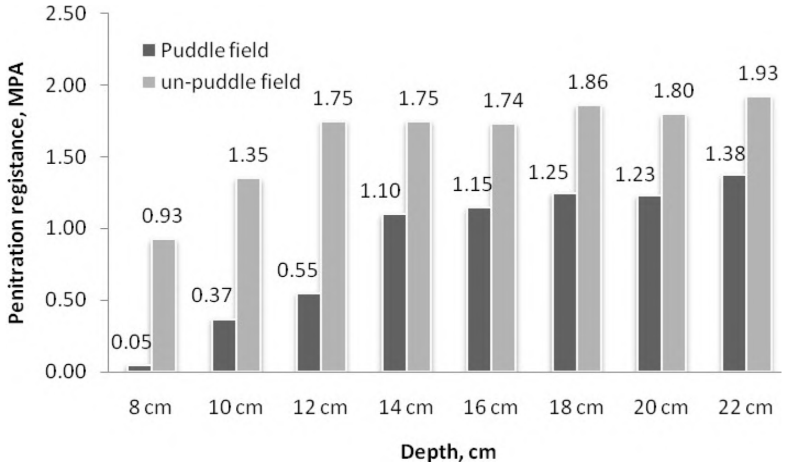

Fig. 4. Cone penetration resistance of clay loam soil during transplanting at Burichong, Comilla

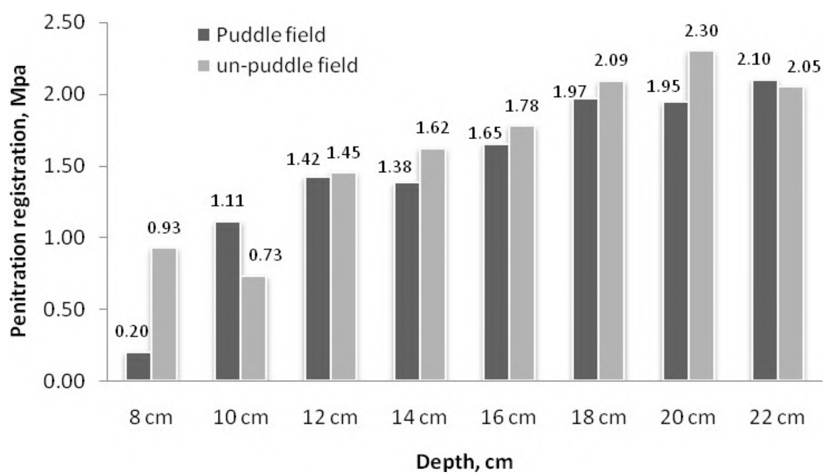

Fig. 5. Cone penetration resistance of sandy loam soil during transplanting at Laksam, Comilla

Cone resistance was varied in three locations due to soil texture. In all cases, penetration resistance reading showed almost zero in the manometer dial up to 8cm in puddle condition. In the un-puddle condition, penetration resistance was around 1 Mpa at 8 cm depth. However, penetration resistances were found 1.7, 1.9 and 2.05 Mpa at 22 cm depth in the locations of Kumarkhali-Kushtia, Burichong-Comilla and Laksam-Comilla. In laksam-Comilla, resistance is more because of sandy loam soil.

3.1 Field performance of mechanical rice transplanter

3.1.1 Transplanter performance

Field performance of mechanical rice transplanter was measured in terms of field capacity and fuel consumption in both puddle and un-puddle fields (Table 3). Field capacity of un-puddle transplanting was found less compare to puddle transplanting. Transplanter operation in un-puddle condition was new for the operator that might be the causes of less field capacity. Average, field capacity was found 0.14 ha/hr and 0.13 ha/hr in puddle and un-puddle field respectively. Average fuel consumption was found more in puddle field that was 5.28 lit/ha whereas it was 4.77 lit/ha in un-puddle field. Among the puddle and un-puddle field, fuel consumption was found more in clay type soil condition. More load due to muddy soil during operation of mechanical rice transplanter in puddle field might be the causes of more fuel consumption.

3.1.2 Transplanting performance

Transplanting performance of the mechanical rice transplanter in both puddle and un-puddle conditions were measured in terms of number of plants/hill, plant to plant distance, depth of planting, number of hills/m^2, number of trays/ha, missing hills/m^2, floating hills/m^2, buried hills/m^2 and damage hills/m^2. In puddle field, average plant to plant distance was found 14.42 cm whereas it was found 14.85 cm in un-puddle field. Slippage was the cause of reduced plant to plant distance in puddle field. On the other hand, transplanting depth almost same in both condition because of control depth of placing. Average total missing hills considering missing, floating, buried and damaged hills was found 3.60 and 4.92 hills/m^2 in puddle and un-puddle field respectively. Floating hills were observed more and buried hills less in un-puddle field. Total percent of missing hills were found more in un-puddle field in all locations due to more floating and damage hills. Floating hills may be reduced by operating the rice transplanter in the field with minimum standing water. Percent of missing hills in puddle and un-puddle conditions were 14.94 and 21.04. In both puddle and un-puddle conditions, % of total missing hills was observed more in clay soil condition and less in sandy loam condition (Table 4).

Table 3. Field performance of the mechanical rice transplanter

Parameters	Puddle field				Un-puddle field			
	Sandy loam soil	Clay loam soil	Clay soil	Avg.	Sandy loam soil	Clay loam soil	Clay soil	Avg.
Area under trials, ha	0.142	0.129	0.154	0.14	0.073	0.081	0.061	0.07
Time of operation, hr	0.95	0.9	1.25	1.03	0.58	0.62	0.45	0.55
Field capacity, ha/hr	0.15	0.14	0.12	0.14	0.13	0.13	0.14	0.13
Fuel consumption, ml	703	621	938	-	336	384	302	-
Fuel consumption, lit/hr	0.74	0.69	0.75	0.73	0.58	0.62	0.67	0.62
Fuel consumption, lit/ha	4.95	4.81	6.09	5.28	4.61	4.75	4.94	4.77

Note: Average of three replications

Table 4. Transplanting parameters of the mechanical transplanting plots

Parameters	Puddle field				Un-puddle field			
	Sandy loam soil	Clay loam soil	Clay soil	Avg.	Sandy loam soil	Clay loam soil	Clay soil	Avg.
No. of plants/hill	3-5	3-6	3-6	-	2-5	3-5	3-5	-
Plant to plant distance, cm	14.75	14.5	14.0	14.42	15	14.80	14.75	14.85
Depth of transplanting, cm	1.5-2.5	1.5-2.5	1.5-3.0	-	1.5-2.0	1.5-2.0	1.5-2.5	-
No. of hills/m^2	23.50	24.00	24.50	24.00	23.00	23.50	23.50	23.33
No. of trays/ha	236	239	240	238.33	232	235	234	233.66
Missing hills/m^2	1.00	1.50	1.00	1.17	0.00	2.00	1.00	1.00
Floating hills/m^2	0.00	0.00	0.00	0.00	2.50	1.75	2.50	2.25
Buried hills/m^2	1.30	1.50	2.50	1.77	0.00	0.00	0.00	0.00
Damage hills/m^2	0.00	1.00	1.00	0.67	1.50	1.50	2.00	1.67
Total missing hills/m^2	2.30	4.00	4.50	3.60	4.00	5.25	5.50	4.92
% of total missing	9.79	16.67	18.37	14.94	17.39	22.34	23.40	21.04

3.2 Yield performance

There was no significant yield variation observed in two tilling condition transplanting by mechanical rice transplanter in studied three locations except Burichong, Comilla (Table 5). In Burichong, yield was significantly higher when land was puddle conventionally before transplanting. In all the cases, higher yield was obtained in puddle condition than un-puddle condition. Although there was no significant difference in studied other two locations but puddle field gave around 0.13 t/ha more yield than un-puddle field. It might be due to produce higher effective tiller/m^2 as well as higher grains/panicles resulted of higher yield (Table 5.1-5.3).

Fig. 6. Mechanical rice transplanter operation in un-puddle and puddle fields

Table 5. Yield in puddle and un-puddle field in three different locations

Treat	Yield (t/ha)			Average yield (t/ha)	
	Sandy loam soil: Laksam	Clay loam soil: Burichong	Clay soil: Kumarkhali, Kushtia	BRRI dhan49	BINA dhan7
	BRRI dhan49	BRRI dhan49	BINA dhan7		
T_1	4.80a	5.40a	4.92a	5.1	4.92
T_2	4.76a	5.03b	4.88a	4.87	4.89
CV, %	8.22	1.71	6.08	-	-
$LSD_{0.05}$	1.374	0.31	1.048	-	-

There was no significant straw yield variation observed in three studied locations. However, in Laksam and Burichong, straw yield was obtained more in puddle field than un-puddle field. Average straw yield in puddle and un-puddle field was found 5.21 and 5.20 t/ha (Table 6).

Table 6. Straw yield in puddle and un-puddle field in different three locations

Treat	Straw yield (t/ha)			Average
	Sandy loam soil: Laksam	Clay loam soil: Burichong	Clay soil: Kumarkhali	
T_1	5.03	5.53	5.07	5.21
T_2	5.00	5.45	5.15	5.20
CV, %	1.63	6.82	1.06	-
Level of significant	NS	NS	NS	-

3.3 Yield parameters, Kumarkhali (Clay soil)

There was no significance difference observed except 1000 grains within all yield contributing parameters. Plant height was found 102.6 and 102.3 cm for two treatments respectively. Average panicle length was 24.48 and 22.83 cm and tillers/m^2 was 361.7 and 404.3 nos. for T_1 and T_2 respectively. Average plant height, panicle length and tillers/m^2 were statistically identical in the both T_1 and T_2. Number of effective tillers was 319.3 and 354.3 nos and filled grains/m^2 was 76.33 and 66.67 nos for T_1 and T_2 respectively whereas 1000 grains weight was 21.12 and 21.47 gm. 1000 grains weight was found significantly less in $T_{1.}$ However, yield was 4.92 and 4.88 ton/ha which was statistically identical for both in T_1 and T_2 (Table 7).

Table 7. Yield and yield contributing parameters, Kumarkhali, Kushtia (Clay soil)

Treat.	Avg. plants height, cm	Avg. Panicle length, cm	Tiller/m^2	No. of effective tiller/m^2	Filled grain/ Panicle	Sterile grain/panicle	1000 grains weight at 14% mc (wb), gm	yield at 14% mc (wb), ton/ha
T_1	102.6a	24.48a	361.7a	319.3a	76.33a	30.67a	21.12b	4.92a
T_2	102.3a	22.83a	404.3a	354.3a	66.67a	25.67a	21.47a	4.88a
CV, %	1.70	3.30	13.22	4.60	4.67	11.50	0.44	6.08
$LSD_{0.05}$	6.113	2.742	177.9	54.48	11.74	11.38	0.3333	1.048

3.4 Yield parameters, Burichong (Clay loam soil)

Significance difference was not observed in the yield contributing parameters. Plant height was found 104.7 and 96.33 cm for two treatments respectively. Average panicle length was 22.77 and 22.89 cm and tillers/m^2 was 395.3 and 333.7 nos. for T_1 and T_2 respectively. Average plant height, panicle length and tillers/m^2 was statistically identical in the both T_1 and T_2. Number of effective tillers was 277 and 253.7 nos and filled grains/m^2 was 98.0 and 99.33 nos for T_1 and T_2 respectively whereas 1000 grains weight was 20.50 and 20.53 gm. Effective tillers/m^2, filled grains/panicle and 1000 grains weight were found statistically identical in both cases. However, yield was observed significantly higher in T_1 compared to T_2 which was 5.4 and 5.03 t/ha respectively (Table 8).

Table 8. Yield and yield contributing parameters, Burichong, Comilla (Clay loam soil)

Treat.	Avg. plants height, cm	Avg. Panicle length, cm	Tiller/m^2	No. of effective tiller/m^2	Filled grain/ panicle	Sterile grain/panicle	1000 grains weight at 14% mc (wb), gm	yield at 14% mc (wb), ton/ha
T_1	104.7a	22.77a	395.3a	277.0a	98.00 a	20.67a	20.50a	5.400a
T_2	96.33a	22.89a	333.7a	253.7a	99.33a	17.33a	20.53a	5.033b
CV, %	3.61	5.07	14.65	7.61	5.08	15.04	0.20	1.71
$LSD_{0.05}$	12.75	4.06	187.60	70.98	17.62	10.04	0.33	0.31

3.5 Yield parameters, Laksam (Sandy loam soil)

There was no significance difference observed in all yield contributing parameters. Plant height was found 94.63 and 86.33 cm for two treatments respectively. Average panicle length was 24.50 and 23.43 cm and tillers/m^2 was 287 and 315 nos. for T_1 and T_2 respectively. Average plant height, panicle length and tillers/m^2 were statistically identical in the both T_1 and T_2. Number of effective tillers was 235 and 239 nos and filled grains/m^2 was 102.3 and 100.3 nos for T_1 and $T_{2,}$ respectively whereas 1000 grains weight 20.12 and 20.10 gm. Effective tillers/m^2, filled grains/panicle and 1000 grains weight were found statistically identical in both cases. However, yield was 4.80 and 4.76 t/ha which is statistically identical in T_2 than T_1 (Table 9).

Table 9. Yield and yield contributing parameters, Laksam, Comilla (Sandy loam soil)

Treat.	Avg. plants height, cm	Avg. Panicle length, cm	Tiller/ m^2	No. of effective tiller/m^2	Filled grain/ panicle	Sterile grain/ panicle	1000 grains weight at 14% mc (wb), gm	yield at 14% mc (wb), ton/ha
T_1	94.63a	24.50a	287.0a	235.0a	102.3a	30.33a	20.12a	4.80a
T_2	86.33a	23.43a	315.0a	239a	100.3a	29.00a	20.10a	4.76a
% of CV	4.81	1.51	3.00	2.88	7.29	13.13	0.90	8.22
LSD value	15.29	1.276	31.72	23.96	25.94	13.68	0.6382	1.374

3.6 Cost-analysis

Cost analysis of the mechanical rice transplanter was done to find out the operating cost in terms of Tk/hr and Tk./ha in both puddle and un-puddle conditions. Operating cost in terms of fixed and variable cost was presented in Table 10 (a & b). Inputs cost for rice production in both puddle and un-puddle conditions are presented in Table 11. Benefit-cost ratio was computed based on total inputs cost including land rent and interest of investment, total production. Benefit-cost ratio computations are also presented in Table 12.

Table 10. Operating cost calculation of mechanical rice transplanter

a. Fixed cost calculation

Sl. No.	Items	Tk.
1	Purchase price (p), Tk	300000
2	Salvage value (S), Tk (10% of p)	30000
3	Working life (L), yr	8
4	[1]Average annual use (Au), hr/yr	560
5	Annual depreciation, D = (P-S)/L	33750
6	Interest on investment, I = (P+S)/2*I, where rate of interest is 12%	18180
7	Tax, insurance, T = 3% of P	9000
8	Total fixed cost (D + I + T), Tk/yr	60930
9	*Total fixed cost, Tk/hr*	108.80

b. Variable cost calculation

Sl. No.	Total variable cost	Puddle	Un-puddle
1	[2]Labour cost per hour, L (Tk/hr)	65	65
2	Fuel cost, Tk/hr	63.75	52.7
3	Lubricant cost , (Tk/hr) (lubricant cost is 3% of fuel const)	1.91	1.58
4	RPM/hr =3.5 % of purchase price	18.75	18.75
5	Total Variable cost (Tk/hr)	149.41	138.03
6	*Total operating cost Tk/hr (Fixed cost+ Variable cost)*	258.21	246.83
7	*Field capacity of rice transplanter, ha/hr*	0.14	0.13
8	*Time for transplanting, hr/ha*	7.14	7.69
9	*Operating Cost for transplanting, Tk/ha*	1844	1898

Note: 1. Average annual use of rice transplanter in three rice season is considered 75 days where 15 days in *Aus*, 25 days in *Aman* and 30 days in *Boro* season. Considering 8 working hrs, Average annual use in hrs/year is 560; 2. Labor cost as operator, Tk/hr = 37.5 and helper cost, Tk/hr = 27.5. Total cost, Tk/hr = 65.0 and Agril. Labor cost, Tk/hr = 280.00; 3. Fuel price (Octane), Tk/lit = 85.00

Table 11. Input cost of rice production as affected by tillage for transplanting using mechanical rice transplanter

Inputs	Puddle condition, Tk/ha	Un-puddle condition, Tk/ha	Comments
Seedling preparation	4800.00	4760.00	Number of trays in puddle field: 238/ha and un-puddle: 233/ha
Land preparation	10500.00	3750.00	Power tiller hired for making puddle
Transplanting	1844.00	1898.00	Based on operating cost of transplanter
Weeding	8400.00	11200.00	30 man-day/ha for puddle and 40 man-day/ha for un-puddle field
Herbicide and pesticide	1800.00	1800.00	Same for all plots
Supplement irrigation	1500.00	1500.00	One supplement irrigation was applied.
Harvesting, carrying, threshing and winnowing	12500.00	12500.00	Same for all plots
Land rent	15000.00	15000.00	Land rent for one crop season @ Tk/ha = 15000.00.
Interest on investment at the rate of 12%	6761.00	6289.00	
Total input cost	63105.00	58697.00	

Table 12. Benefit-cost ratio (BCR) calculation

Tillage option	Input cost (Tk/ha)	Gross return (Tk/ha)	Gross margin (Tk/ha)	BCR
Conventional tillage (Puddle condition)	63105	93927	30822	1.49
Zero tillage (Un-puddle condition)	58697	91640	32943	1.56

Note: Values are the means of three replications. Market price of straw, Tk/ton: 1200.00 and Paddy, Tk/ton: 17500.00

4. Conclusion

Mechanical rice transplanter was found suitable to operate in both puddle and un-puddle conditions. For un-puddle transplanting, inundation of land for making the soil soft and weeds out were the pre-requisite management. Plant to plant distance was found less in puddle field compared to un-puddle field at the same adjustment because of slippage. Total percent of missing hills were also found more in un-puddle field in all locations due to more floating and damage hills. Floating hills may be reduced by operating the rice transplanter in the field with minimum standing water. Percent of total missing hills was found more in clay soil condition where as it was observed less in sandy loam condition. However, field capacity was found less in un-puddle condition compared to puddle condition because of more vibration of the transplanter in un-puddle condition. Yield and yield contributing characters have no significant different in puddle and un-puddle field. BCR of rice production under puddle and un-puddle conditions, transplanting by mechanical transplanter, was gave 1.49 and 1.56 respectively. BCR of rice production in un-puddle condition was more compared to puddle condition in *Aman* season.

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